7TH SEMESTER

IPCC Automotive Chassis and Suspension		Semester	6
Course Code	**BAU701**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- Explain different chassis layouts and frames, Suspensions, Wheels and Tyres, Propeller Shaft, Differential and Rear Axles, etc.
- Determine stability and weight distribution and suitability of frames.
- Calculate dimensions of major chassis components.
- Describe, about various Front Axles, factors of wheel alignment Steering Systems and Calculate dimensions of Front Axle.
- Compare various types of Brakes and solve numerical.
- Diagnose the troubles of chassis components and suggest remedies.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

MODULE-1

Introduction: General consideration relating to chassis layout, power location, types of automobiles, layout of an automobile with reference to power plant, weight distribution, stability, Numerical problems. **Frames:** Types of frames ,general form & dimensions, materials, frame stresses, frame sections, cross members, proportions of channel sections, constructional details, loading points, sub frames, passenger car frames, X member type frame, Box section type frame, testing of frames, bending and torsion test, effect of brake application of frame stresses, truck frames, defects, Numerical problems.

MODULE-2

Front Axle and Steering Systems: Axle parts and materials, loads and stresses, center sections, section near steering head, spring pads, front axle loads, steering heads, factors of wheel alignment, wheel balancing, center point steering, correct steering angle, steering mechanisms, cornering force, self-righting torque, under steer and over steer, Steering linkages, steering gears, special steering columns, power steering, trouble shooting, Numerical problems.

MODULE-3

Propeller Shaft: Construction& types of propeller shafts, whirling of propeller shaft, universal joints, analysis of Hooke's joint- ratio of shafts velocities, maximum & minimum speeds of driven shaft, condition for equal speeds of thee driving &driven shafts, angular acceleration of the driven shaft, maximum fluctuation of speed, double Hooke's joint, Numerical problems.

Final drive: Construction details, types.

Differential: Principle, types of differential gears, conventional and non-slip differentials, backlash, differential lock, inter-axle differential, transaxle types.

Rear axle: Torque reaction, driving thrust, Hotchkiss drive, torque tube drive, construction of rear axle shaft supporting- fully floating and semi floating arrangements axle housings, trouble shooting, numerical problems.

MODULE-4

Brakes: Necessity, stopping distance and time, brake efficiency, weight transfer, brake shoe theory, determination of braking torque, classification of brakes, types, construction, function, operation, braking systems - mechanical, hydraulic, disc, drum, details of hydraulic system, types of master, wheel cylinder, bleeding of brakes, brake drums, brake linings, brake fluid, factors influencing operation of brakes such as operating temperature, lining, brake clearance, pedal pressure, linkages etc., Brake compensation, Parking and emergency brakes, hill holder, automatic adjustment, servo brakes, Power brakes-Air brakes, vacuum brakes and electric brakes and components brake valve, unloaded valve, diaphragm, air-hydraulic brakes, vacuum boosted hydraulic brakes, trouble shooting.

MODULE-5

Suspension system: Objects, basic considerations, Types of suspension springs, construction, operation & materials, leaf springs, coil springs, torsion bar, rubber springs, plastic springs, air bellows or pneumatic suspension, hydraulic suspension, constructional details of telescopic shock absorbers, independent suspension, front wheel independent suspension, rear wheel independent suspension, types, stabilizer, trouble shooting.

Wheels and Tyres: Types of wheels, construction, structure and function, wheel dimensions, structure and function of tyres, static and dynamic properties of pneumatic tyres, types of tyres, materials, tyre section & designation, factors affecting tyre life, quick change wheels, special wheels, trouble shooting.

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl. NO	Experiments
1	Demonstration of basic structure of chassis and frames. Interaction between the teaching staff and the student.
2	Practical Topics (Interactive session): Demonstration of different type's axle and steering system: interaction between the teaching staff and the student.
3	Practical Topics: Demonstration of cut section of propeller shaft, final drive, differential, rear axle. Interaction between the teaching staff and the student.
4	Demonstration of cut section of different types of brakes and working. Interaction between the teaching staff and the student.
5	Demonstration of working of types of suspension system

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- . Explain different chassis layouts and frames, Suspensions, Wheels and Tires, Propeller Shaft, Differential and Rear Axles, etc.
- Determine stability and weight distribution and suitability of frames.
- Calculate dimensions of major chassis components.
- Describe, about various Front Axles, factors of wheel alignment Steering Systems and Calculate dimensions of Front Axle.
- Compare various types of Brakes and solve numerical.
- Diagnose the troubles of chassis components and suggest remedies.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum

passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

CIE for the theory component of the IPCC

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be 10 (40% of maximum marks-25) in the theory component and 10 (40% of maximum marks -25) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 sub-questions are to be set from the practical component of IPCC, the total

marks of all questions should not be more than 20 marks.

- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.
- The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Suggested Learning Resources:

Books

1. Automobile Engineering, Kirpal Singh, Standard publications, New Delhi12th edition Vol. I, 2009.
2. Automotive Mechanics,N. K. Giri Khanna Publications, New Delhi2008.
3. Steering, Suspension and Tyres,Giles. J. G. Iiiffe Book Co., London 1988.
4. Automotive Chassis,Heldt P. M Chilton Co., Literary Licensing, LLC,2012.
5. Automotive chassis and body,P. L. Kohli TMH. 2002

Web links and Video Lectures (e-Resources):

1. https://www.european-aluminium.eu/media/1555/aam-applications-chassis-suspension-0-introduction.pdf
2. https://www.youtube.com/watch?v=qfkTVYJIx8Q
3. https://axleaddict.com/cars/automotive-chassis-system
4. https://gomechanic.in/blog/car-suspension-explained/
5. https://www.thedrive.com/cars-101/39840/what-is-a-chassis
6. https://www.youtube.com/watch?v=PjenO8nihaM
7. https://wiregrass.libguides.com/c.php?g=1035978&p=7510014
8. https://www.youtube.com/watch?v=vaOrx-fqG0s

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **Chassis Design Projects**: Divide students into groups and assign them to design different types of chassis for specific vehicle applications (e.g., passenger cars, off-road vehicles, racing cars)
2. **Suspension System Analysis**: Provide students with real-world suspension system data from different vehicle models. Ask them to analyse the suspension geometry, including the types of suspension components used (e.g., double wishbone, MacPherson strut) and their arrangements.
3. **Prototype Construction**: Encourage students to build physical prototypes of suspension components or chassis structures using readily available materials such as cardboard, foam board, or 3D-printed parts.
4. **Vehicle Dynamics Simulation**: Introduce students to vehicle dynamics simulation software such as CarSim or Adams Car. Students can use these tools to simulate the behaviour of different vehicle configurations under various driving conditions, including acceleration, braking, and cornering.
5. **Crashworthiness Analysis**: Explore the concept of crashworthiness in automotive design by analyzing crash test data and conducting virtual crash simulations.
6. https://auto.howstuffworks.com/car-suspension.htm ; https://ncert.nic.in/vocational/pdf/ivas103.pdf; https://en.wikipedia.org/wiki/Automotive_suspension_design_process

IPCC **Hydraulics and Pneumatics**		Semester	7
Course Code	**BAU702**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

1. Explain basics of Hydraulics and pneumatics.
2. Describe Various components of hydraulic system and maintenance of hydraulic system
3. Design hydraulic system.
4. Describe layout and details of pneumatic systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class.
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

MODULE-1

Introduction to Hydraulic Power: Pascal's law, The Source of Hydraulic Power: Pumps Pumping theory, pump classification, gear pumps, vane pumps, piston pumps, pump performance, variable displacement pumps. **Hydraulic Actuators and Motors:** Linear Hydraulic Actuators [cylinders], Mechanics of Hydraulic Cylinder loading, Hydraulic Rotary Actuators, Gear motors, vane motors and piston motors.

MODULE-2

Control Components in Hydraulic Systems: Directional Control Valves – Symbolic representation, Constructional features, pressure control valves – direct and pilot operated types, flow control valves. **Maintenance of Hydraulic systems:** Hydraulic oils – Desirable properties, general type of fluids, sealing devices, reservoir system, filters and strainers, problem caused by gases in hydraulic fluids, wear of moving parts due to solid particle contamination, temperature control, trouble shooting

MODULE-3

Hydraulic Circuit Design and Analysis: Control of single and Double – acting Hydraulic cylinder, regenerative circuit, pump unloading circuit, Double pump Hydraulic system, Counterbalance Valve application, Hydraulic cylinder sequencing circuits. Locked cylinder using pilot check valve, cylinder synchronizing circuits, speed control of hydraulic cylinder, speed control of hydraulic motors, accumulators and accumulator circuits.

MODULE-4

Pneumatic Controls: Choice of working medium, characteristics of compressed air, preparation of compressed air- Driers, Filters, Regulators, Lubricators, Distribution of compressed air- Piping layout. **Pneumatic Actuators**: Linear cylinders – Types, conventional type of cylinder working, end position cushioning, seals. Rod-less cylinders – types, working advantages. Rotary cylinder types construction. **Directional Control valves**: Design and constructional aspects, poppet valves, slide valves spool valve, suspended seat type slide valve.

Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders. Flow control valves and speed control of cylinders supply air throttling and exhaust air throttling use of quick exhaust valve.

MODULE-5

Multi-cylinder Applications: Coordinated and sequential motion control. Motion and control diagrams – Signal elimination methods. Cascading method – principle. Practical application examples (up to two cylinders) using cascading method (using reversing valves).

Electro-Pneumatic control: Principles-signal input and output pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple single cylinder applications.

PRACTICAL COMPONENT OF IPCC *(May cover all / major modules)*

Sl.NO	Experiments
1	Operate hydraulic components within manufacturer's specified limits.
2	Control of a single acting cylinder using Hydraulic Circuits.
3	Control of a double acting cylinder using Hydraulic Circuits.
4	Control of a single acting cylinder using Pneumatic Circuits.
5	Control of a double acting cylinder using Pneumatic Circuits.
6	Control double-acting cylinder with limit switches using pilot operated valve.
7	Use Accumulators in hydraulic circuits.
8	Compare circuit operation when hydraulic motors are connected for Meter-Out vs.
9	Meter-In configurations.
10	Use Safety Relief Valves in pneumatic circuits.
11	Use Rotary Actuators in pneumatic circuits.
12	Measure Flow and Pressure Drop.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Introduce basics of Hydraulics and pneumatics.
- Describe Various components of hydraulic system and maintenance of hydraulic system
- Design hydraulic system.
- Describe layout and details of pneumatic systems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

CIE for the theory component of the IPCC

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be 10 (40% of maximum marks-25) in the theory component and 10 (40% of maximum marks -25) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 sub-questions are to be set from the practical component of IPCC, the total marks of all questions should not be more than 20 marks.
- SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.

- The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Suggested Learning Resources:

Books

1. Fluid Power with applications, Anthony Esposito Pearson education, Inc 2000.
2. Pneumatics and Hydraulics, Andrew Parr Jaico Publishing Co. 2000.
3. Systems – Principles and Maintenance, S. R. Majumdar, Tata McGraw Hill publishing company Ltd. 2001
4. Pneumatic systems, S. R. Majumdar Tata McGraw Hill publishing Co1995.
5. Industrial Hydraulics, Pippenger Hicks McGraw Hill, New York. 2001
6. Fluid Power Systems, R.K. Hegde , Sapna Book House, Ist edition, Oct.2018, ISBN: 978-93-88587-01-3

Web links and Video Lectures (e-Resources):

1. https://www.nexflow.com/blog/difference-between-pneumatics-and-hydraulics/
2. https://en.wikipedia.org/wiki/Hydraulics
3. https://www.explainthatstuff.com/hydraulics.html
4. https://fpsindia.net/how-do-hydraulics-work/
5. https://www.hafner-pneumatik.com/basic_concepts_of_pneumatics
6. https://www.youtube.com/watch?v=TjHNrvsx5bQ
7. https://www.youtube.com/watch?v=OP8n0KR4hA4
8. https://www.youtube.com/watch?v=NIxkUwtRnWA

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **Hands-On Assembly and Disassembly**: Provide students with hydraulic and pneumatic components (such as cylinders, valves, pumps, etc.) and task them with assembling and disassembling these systems.
2. **Circuit Design and Troubleshooting**: Assign students to design hydraulic and pneumatic circuits for specific tasks or applications.
3. **Fluid Power Simulation Software**: Introduce students to simulation software like Automation Studio or FluidSIM, which allows them to design and simulate hydraulic and pneumatic systems virtually; Lab volt software to learn hydraulics https://labvolt.festo.com/solutions/3_fluid_power/98-6385-00_hydraulics_simulation_software_lvsim_hyd, https://library.automationdirect.com/pneumatic-system/, https://www.ispatguru.com/basics-of-pneumatics-and-pneumatic-systems/, https://manualzz.com/doc/7377199/hydraulics-simulation-software--lvsim%C2%AE-hyd---model-6385--...
4. **Guest Lectures from Industry Experts**: Invite professionals from the hydraulic and pneumatic industry to give guest lectures or workshops.
5. **Integration with Mechatronics**: Integrate hydraulic and pneumatic systems with mechatronics concepts by combining them with sensors, actuators, and programmable logic controllers (PLCs).

PCC **Application of AI in Automotive Vehicles**		Semester	7
Course Code	**BAU703**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	4-0 -0	SEE Marks	50
Total Hours of Pedagogy	50	Total Marks	100
Credits	04	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- Understand the core concepts of Mechanical Systems in the context of Industry 4.
- Apply AI, ML and Deep Learning concepts on Various Mechanical Systems
- Apply the statistical and optimization techniques on Mechanical Systems
- Evaluate the Mechanical System performance using simulation and experimental analysis

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to Mechanical Systems evolution in the context of Industry 4.0, Key issues: Adaptability, Intelligence, Autonomy, Safety, Sustainability, Interoperability, Flexibility of Mechanical Systems.

Introduction of Statistics; Descriptive statistics: Central tendency measures, Dispersion measures, data distributions, centre limit theorem, sampling, sampling methods; Inferential Statistics: Hypothesis testing, confidence level, degree of freedom, P-value, Chi-square test, ANOVA, Correlation V's Regression, Uses of Correlation and regression.

Module-2

Introduction: Overview of AI problems, examples of successful recent AI applications. The Turing test, Rational versus non-rational reasoning.

Search Strategies: Problem spaces (states, goals and operators), problem solving by search. Uninformed search (breadth-first, depth-first, depth first with iterative deepening). Heuristics and informed search (hill-climbing, generic best-first, A*). Minimax Search, Alpha-beta pruning

Module-3

Artificial Intelligence: Brief review of AI history, Problem formulation: Graph structure, Graph implementation, state space representation, search graph and search tree, Search Algorithms: random search, Depth-first, breadth-first search and uniform-cost search. Heuristic: Best first search, A* and AO* algorithm, generalization of search problems. Ontology; Fuzzy; Meta-heuristics.

Knowledge representation and reasoning: Review of propositional and predicate logic, first order logic, Resolution and theorem proving, Forward chaining, Backward chaining, Temporal and spatial reasoning. Review of probabilistic reasoning, Bayes theorem. Totally ordered and partially ordered Planning

Module-4

Planning-The blocks world, Components of Planning Systems, Goal stack planning, Nonlinear planning, Hierarchical planning. Learning-Learning from example, learning by advice, Explanation based learning, learning in problem solving, Definition and examples of broad variety of machine learning tasks, Classification, Inductive learning, Simple statistical-based learning such as Naive Bayesian Classifier, decision trees.

Natural Language Processing: Language models, n-grams, Vector space models, Bag of words, Text classification, Information retrieval, PageRank, Information extraction, Question-answering

Agents: Definition of agents, Agent architectures (e.g., reactive, layered, cognitive), multi-agent systems- Collaborating agents, Competitive agents, Swarm systems and biologically inspired models. Expert Systems: Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.

Module-5

Machine Learning: Overview of supervised and unsupervised learning; Supervised Learning: Linear Regression, Non-linear Regression Model evaluation methods, Logistic Regression, Neural Networks; Unsupervised Learning: K-means clustering, C-means Clustering. Convolutional Neural Networks (CNN), Pooling, Padding Operations, Interpretability in CNNs, Limitations in CNN. Cases with respect to different mechanical systems.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

- Understand the core concepts of Mechanical Systems in the context of Industry
- Apply AI, ML and Deep Learning concepts on Various Mechanical Systems
- Apply the statistical and optimization techniques on Mechanical Systems
- Evaluate the Mechanical System performance using simulation and experimental analysis

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, Wesley Professional.
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015.
3. Robert Levine et al., "A Comprehensive guide to AI and Expert Systems", McGraw Hill Inc, 1986.
4. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber-Physical Systems Approach", 2011.
5. C. Cassandras, S. Lafortune, "Introduction to Discrete Event Systems", Springer 2007.
6. Constance Heitmeyer and Dino Mandrioli, "Formal methods for real-time computing", Wiley publisher, 1996.
7. Montgomery Douglas, 2017. Design of Experiments, John Wiley and Sons, Inc
8. Elaine Rich, Kevin Knight and Shivashankar BNair, Artificial Intelligence Tata McGraw Hill3rd Edition 2009
9. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems Pearson Education1st Edition, 2015
10. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach Prentice Hall, 3rd Edition 2009

Masoud Yazdani, Artificial Intelligence: Principles and Applications, Chapman and Hall, 1986 Digital Edition,2008

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=OkAh2QiBn_w
2. https://www.youtube.com/watch?v=uO0U-6N7x1A
3. https://www.youtube.com/watch?v=AOFn2yKAI_8
4. https://www.youtube.com/watch?v=xW3fv5RYlGY
5. https://www.youtube.com/watch?v=K0imqzTWFOs

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **AI-Powered Vehicle Systems Analysis:** Provide students with data on various AI-powered vehicle systems such as autonomous driving, predictive maintenance, and intelligent navigation.
2. **Simulated Autonomous Driving Projects:** Divide students into groups and assign them to develop AI algorithms for simulated autonomous driving scenarios using platforms like CARLA or NVIDIA DRIVE Sim.
3. **Embedded AI Hardware Projects**: Guide students in developing embedded AI hardware projects for automotive applications using platforms like NVIDIA Jetson or Raspberry Pi. Students can build AI-powered systems for tasks such as object detection, lane tracking, or driver monitoring using onboard sensors and cameras
4. **Ethical and Legal Implications Discussions**: Organize discussions or debates on ethical and legal implications of AI in automotive vehicles, including issues such as liability, privacy, and societal impacts
5. **Capstone Projects and Hackathons**: Encourage students to work on capstone projects or participate in hackathons focused on AI in automotive vehicles.
6. **https://nptel.ac.in/courses/106106198; Certification program on the above course offered by NPTEL; https://nptel.ac.in/courses/106105166/**

PEC **Safety of Electric Vehicles**		Semester	7
Course Code	**BAU714A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- To Identify safety systems of automobiles
- To Classify safety systems and components
- To describe the working principles of comfort and convenience systems
- To Examine vehicle maintenance.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction: Design of the vehicle body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumble zone, safety sandwich construction.

Module-2

Safety Concepts: Active safety, driving safety, conditional safety, perceptibility safety, operating safety, passive safety: exterior safety, interior safety, deformation behaviour of vehicle body, speed and acceleration characteristics of passenger compartment on impact

Module-3

Active Safety: Cruise control system, Lane departure warning, Tire pressure monitoring system, electronic braking.

Passive Safety Equipment's: Seat belt, regulations, automatic seat belt tightener system, collapsible steering column, tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

Module-4

Collision Warning and Avoidance: Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

Comfort and Convenience System: Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system.

Module-5

Preventive Maintenance of Engine and Transmission Line: Maintenance of cooling and lubricating systems, engine management service - fault diagnosis- servicing emission controls. Scheduling of maintenance of light duty, heavy duty vehicles

Clutch, transmission, axles: general checks, adjustment and service, fault diagnosis. Steering, Brake, Suspension, and Wheel Maintenance: Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, Parking brake. Bleeding of brakes. Inspection, Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation. Inspection, Maintenance and Service of steering linkage.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Identify different safety systems and its role in automobiles
2. Classify active, passive safety systems and components
3. Describe the working principles of airbag, ABS, seat-belt controls, comfort and convenience systems
4. Examine vehicle maintenance, trouble shooting and suggest as remedial measures.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Automotive Handbook, Bosch, 8 th Edition, SAE publication, 2011.
2. Automotive Mechanics, Srinivasan, S, 2nd Edition, Tata McGraw- Hill, 2015
3. An Introduction to Modern Vehicle Design, JullianHappian-Smith, SAE, 2002
4. Crashworthiness of Vehicles, Johnson, W., and Mamalis, A.G., MEP, London, 1995
5. Rollover Prevention, Crash Avoidance, Crashworthiness, Ergonomics and Human Factors, SAE Special Publication, November 2003

Web links and Video Lectures (e-Resources):

1. .https://www.youtube.com/watch?v=rqUDzNHKE_U
2. https://www.youtube.com/watch?v=Ri_B2DIrXUI
3. https://www.youtube.com/watch?v=NHD6H27iCvQ
4. https://www.youtube.com/watch?v=r4DAxfO4gow
5. https://www.firerescue1.com/fire-prevention/videos/electric-vehicle-safety-training-preview-bRGTo1WiuD1vFukK/
6. https://www.nfpa.org/EV
7. https://www.youtube.com/watch?v=h1VTFpnTkck

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **Battery Safety Demonstrations:** Conduct demonstrations on battery safety features and precautions. Show students how lithium-ion batteries work, discuss potential hazards such as thermal runaway, and demonstrate safety measures such as battery management systems (BMS), thermal management systems, and crash protection mechanisms
2. **Battery Pack Disassembly and Analysis:** Provide students with decommissioned battery packs or modules from electric vehicles (ensuring safety protocols are followed). Task them with disassembling the packs under supervision and analysing the internal components, including cells, modules, cooling systems, and safety features
3. **Crash Testing and Analysis**: Introduce students to crash testing methodologies for electric vehicles and discuss safety standards such as NCAP (New Car Assessment Program)
4. **Vehicle Safety Technology Workshops**: Organize workshops on advanced safety technologies used in electric vehicles, such as collision avoidance systems, pedestrian detection, lane departure warning, and autonomous emergency braking.
5. **Case Studies and Incident Analysis**: Present students with real-world case studies of electric vehicle accidents or safety incidents.
6. **NPTEL Certification course:https://nptel.ac.in/courses/108102121**
7. **NPTEL Certification course: https://www.youtube.com/watch?v=W_Fp7nGgz9k**

PEC **Total Quality Management**		Semester	7
Course Code	**BAU714B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- To Identify safety systems of automobiles
- To Classify safety systems and components
- To describe the working principles of comfort and convenience systems
- To Examine vehicle maintenance.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby plants, the quality inspection section or quality control department of industries to give brief information about the quality initiatives.
3. Show Video/animation films to explain functioning of various quality checking measures, tools and techniques
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teachers can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to TQM:

Introduction-Definition, Basic Approach, and Contribution of Gurus - TQM framework, Historical Review, Benefits of TQM, TQM organization.

Leadership, Customer Satisfaction and Employee Involvement:

Characteristics of quality leaders, Customers satisfaction, Customer perception of quality, Feedback, Using customer's complaints, Employee involvement - Introduction,

Module-2

Continuous Process Improvement and Tools Techniques:

The juran trilogy, improvement strategies, types of problems, the PDSA cycle, problem solving methods, Kaizen, reengineering, six sigma, Process of benchmarking, quality function deployment, quality by design, Simple numerical treatment wherever applicable

Module-3

Quality Management Tools:

Why- why forced filed analysis, nominal group techniques, affinity diagram, interrelationship diagram, Tree diagram, matrix diagram, process decision programme chart, activity network diagram, prioritization matrices., Simple numerical treatment wherever applicable

Module-4

Human Resource Practices:

Scope of Human Resources Management, leading practices, designing high performance work systems-work and job design, Recruitment and career development, Training and education, Compensation and recognition, Health, safety and employee well-being, performance appraisal. Pareto diagram, process flow diagram, cause and effect diagram, check sheets, histograms, statistical fundamentals, Control charts, state of control, out of control process, control charts for variables, control charts for attributes, scatter diagrams, case studies, , Simple numerical treatment wherever applicable

Module-5

Statistical Process Control:

Parato diagram, process flow diagram, fishbone diagram, histograms, check sheets, statistical fundamentals. Control charts, types of control charts, scattered diagrams case studies and numerical problems, Simple numerical treatment wherever applicable

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

1. Explain basic concepts of TQM, leadership qualities, different factors of customer satisfaction andbenefits of involvement of employee in quality management
2. Describe various techniques for continuous process improvement and its benefits, importance ofHR dept.
3. Apply various tools and techniques in industries to achieve the higher productivity
4. Conduct recruitment process, training of employee and use various graphical representation of process behaviour in TQM

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Total Quality Management: Dale H. Besterfield, Publisher -Pearson Education India, ISBN: 8129702606, Edition 03.
2. Total Quality Management for Engineers: M. Zairi, ISBN:1855730243, Publisher: Wood head Publishing
3. Managing for Quality and Performance Excellence by James R.Evans and Williuam M Lindsay,9th edition, Publisher Cengage Learning.
4. . A New American TQM, four revolutions in management, ShojiShiba, Alan Graham, David Walden, Productivity press, Oregon, 1990
5. Organizational Excellence through TQM, H. Lal, New age Publications, 2008

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=NWsw9tKhRg8
2. https://www.digimat.in/nptel/courses/video/110104085/L01.html
3. https://www.youtube.com/watch?v=umqtSNPp5Dk
4. https://www.youtube.com/watch?v=8qaYone7J_A
5. https://www.youtube.com/watch?v=85Y8iBhzqwk

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **Quality Improvement Projects:** Assign students to quality improvement projects where they analyze a process within a chosen organization or industry. Students can use tools like process mapping, fishbone diagrams, and Pareto charts to identify areas for improvement, implement corrective actions, and measure the impact of their interventions
2. **Quality Circle Meetings**: Organize quality circle meetings where students form small groups to discuss quality issues, brainstorm solutions, and propose recommendations for improvement
3. **Statistical Process Control (SPC) Exercises**: Introduce students to statistical process control methods for monitoring and controlling quality in manufacturing and service processes.
4. **Total Productive Maintenance (TPM) Games**: Organize games or simulations to teach students about Total Productive Maintenance (TPM) principles and practices.
5. **Kaizen Events**: Facilitate Kaizen events or continuous improvement workshops where students work together to identify waste, streamline processes, and implement incremental improvements.
6. NPTEL Certficationcourse :https://onlinecourses.nptel.ac.in/noc20_mg34/preview
7. NPTEL Certficationcourse :https://www.youtube.com/watch?v=SMOQV2CyVQo

PEC **Infotainment & Cyber Physical System**		Semester	7
Course Code	**BAU714C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- Understand the basics of infotainment and cyber security systems
- Learn different types of cyber security issues and operating system
- Understand essentials of cryptography, program, web, network, and Operating system details

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving station and substations to give brief information about the electrical power generation.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to Infotainment Systems: Infotainment Systems on Fast Forward, Adaptive In-Vehicle Information Systems and Their Usability Evaluation ,

Infotainment System Immunity Characterization Via Bulk Current Injection, Incorporating Hard Disks in Vehicles - Usages and Challenges, **Multi**-User Infotainment System

Module-2

Introduction to Cyber security: Security Goals, Attacks, Services and Mechanisms – Techniques – Understanding Threats.

CRYPTOGRAPHY:

Basic encryption and decryption – Substitution, Transposition – AES- Public key cryptosystem: RSA cryptosystem –Data Integrity- Cryptography hash functions- Digital Signatures-Digital signature standard (DSS)- Authentication- Passwords- Biometrics-Interactive protocol- Key management –Diffie –Hellman Key exchange- Digital certificates.

Module-3

PROGRAM SECURITY: Secure Programs – Buffer overflows – Malware – viruses and other malicious code – Targeted Malicious code –Defense Mechanism.

Module-4

NETWORK SECURITY:

Security at application layer: email security – SMIME- Security at transport layer: SSL protocol. Security at network layer: firewalls – intrusion detection system – IPsec

Module-5
WEB SECURITY: Overview, various types of web application vulnerabilities, Reconnaissance, Authentication, Authorization (Fuzzing and Privilege Escalation), Session Management, Cross Site Scripting (XSS),Cross Site Request Forgery (CSRF), SQL Injection and Blind SQL Injection. **OS SECURITY:** Memory and Address protection – Access Control –file protection mechanisms –User authentication –models of security –Trusted OS design.
Course outcome (Course Skill Set) At the end of the course the student will be able to : 1. Understand the basic functions of infotainment and cyber security systems 2. Analyse the types of cyber security issues and operating system issues 3. Apply the knowledge of security issues and diagnose the problem 4. Compare the different types of infotainment and cyber security systems used by the automotive manufacturers
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:** • There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component. • Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks • Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks) • The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks. **Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.** **Semester-End Examination:** Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).** 1. The question paper will have ten questions. Each question is set for 20 marks. 2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module. 3. The students have to answer 5 full questions, selecting one full question from each module. 4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Infotainment Systems, Ronald K. Jurgen, ISBN: 0768019435 / 9780768019438, Publisher: SAE, Year: 2007
2. James Graham, Richard Howard and Ryan Olson, "Cyber Security Essentials", CRC Press, USA, 2011
3. Behrouz A Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", Tata Mc-Graw Hill, 2010.
4. William Stallings, "Cryptography and Network Security", Prentice Hall, 2006.
5. Roberta Bragg, Mark Rhodes, Keith Strass Berg J, "Network Security- The Complete Reference", Tata McGraw Hill, 2006.
6. Brian Sullivan, Vincent Liu, "Web Application security: A beginner's guide, Tata McGraw Hill, 2012.
7. Charles P Fleeger, Shari Lawrence P Fleeger, "Security in Computing", Pearson Education, 2004.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=xMp5b8s67AU
2. https://www.youtube.com/watch?v=fRi-ub6so-Y
3. https://www.rohde-schwarz.com/in/applications/video-quality-testing-of-automotive-infotainment-devices-application-card_56279-533068.html
4. https://nptel.ac.in/courses/106106129
5. https://www.mckinsey.com/~/media/mckinsey/industries/automotive%20and%20assembly/our%20insights/cybersecurity%20in%20automotive%20mastering%20the%20challenge/cybersecurity-in-automotive-mastering-the-challenge.pdf

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **Infotainment System Design Projects**: Divide students into teams and assign them to design and prototype infotainment systems for vehicles or smart devices
2. **Cybersecurity Workshops**: Organize workshops on cybersecurity principles and practices relevant to CPS, focusing on topics such as secure communication protocols, data encryption, access control mechanisms, and intrusion detection systems
3. **Vehicular Communication Simulations**: Introduce students to vehicular communication technologies such as Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication. Use simulation tools like Veins or OMNeT++ to simulate traffic scenarios and evaluate the performance of communication protocols for safety-critical applications
4. **Real-Time Embedded Systems Projects:** Guide students in developing real-time embedded systems for CPS applications, such as real-time data acquisition, control systems, or sensor fusion. Students can use microcontroller platforms like Arduino, STM32, or Raspberry Pi to implement real-time algorithms and interface with sensors and actuators.
5. **NPTEL Certification course:https://www.youtube.com/watch?v=9PZb6MlYGlo**
6. **Coursera Certification course:https://www.coursera.org/learn/cyber-physical-systems-1**

PEC **Noise Vibration Harshness**		Semester	7
Course Code	**BAU714D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3 -0 -0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- To introduce the concepts of noise, vibration and harshness
- To introduce the various measuring techniques
- To identify interior, exterior and other sources of noise
- To identify and measure the various sources of vibrations

Teaching-Learning Process (General Instructions)

These are sample Strategies that teachers can use to accelerate the attainment of the various course outcomes.

1. The lecturer method (L) does not mean only the traditional lecture method. Still, different teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain the definition of noise, sound, vibration and harshness
3. Encourage collaborative (Group Learning) Learning in the class
4. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
6. Topics will be introduced in multiple representations.
7. Show the different ways to solve the same problem and encourage the students to come up with creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Individual teachers can devise innovative pedagogy to improve teaching-learning.

Module-1

Fundamentals of sound:

Definition of NVH, Vehicle noise - Direct sound generation mechanism: airborne sound; Indirect sound generation mechanism: structure-borne sound; Subjective response sound, basic attributes of sound, Measures of sound

Module-2

Noise measurements and Instrumentation:

Measuring microphones, Sound level meter, time and frequency weighting, Sound spectra – Octave band analysis, Order analysis and waterfall plot, Various types of acoustic testing chambers, Sound power measurement from Sound pressure: Two- microphone probe for measuring; Sound power measurement from Sound Intensity

Module-3

Vehicle Interior and Exterior noise:

Internal noise sources in vehicles such as engine noise; road noise; aerodynamic (wind) noise; brake noise; squeak, rattle and tizz noises; sound package solution to reduce the interior noise: acoustic isolation, acoustic absorption and damping material solutions; Exterior noise sources in vehicles such as air intake systems and exhaust systems; Tyre noise.

Sources of Vehicle Vibration:

Power train and Engine vibrations; driveline vibrations; chassis and suspension vibrations; Control strategies; Human response to vehicle vibrations, the concept of harshness; subjective and objective evaluation of vehicle harshness.

Module-4

Vibration Isolation and Control:

Introduction to vibrations; Fundamentals of vibrations like frequency and time period and issues of vibrations in automobile, damping of vibrations; vibration isolation and absorption; design of a Vibration Absorbers, unconstrained and constrained layer damping treatment, add on dampers and stiffeners, Introduction to Active Vibration Control

Module-5

Vibration Measurement and Instrumentation:

Definition of Modal Properties, Modal analysis theory, FE & Experimental modal analysis, Transducers and accelerometers Excitation sources Impact Excitation, Shaker excitation, Excitation signals, applications of Modal Analysis, laser based vibration measurements; analysis and presentation of vibration data.

Course outcome (Course Skill Set)

1. Understand and explain basics of Noise Vibration and Harshness.
2. Use different instruments and analyse the data to identify sources of noise and vibrations.
3. Understand /analyze, model and measure various sound and noise sources.
4. Identify the sources of vibration analyse the problem and suggest remedies for vibration damping.
5. Possess the knowledge of vibration measurement and instrumentation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Bies D. A. and Hansen C. H., Engineering Noise Control: Theory and Practice-, Spon Press, Taylor &Francis, NYUSA, 2003.
2. William W. Seto, Theory and Problems of Mechanical Vibrations, McGraw Hill International BookCo., Singapore, Illustrated Edition, 1964
3. S. S. Rao, Mechanical Vibrations, Pearson Education Inc., 5th Edition, 2010
4. S. Graham Kelly, Mechanical Vibrations, Schaum's Outline Series, Tata McGraw Hill Publishing Co.Ltd. SI Edition, 2000

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc19_me72/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **NVH Measurement Lab**: Set up a laboratory session where students can learn to use NVH measurement equipment such as accelerometers, microphones, and vibration analyzers.
2. **Vehicle NVH Testing**: Organize a field trip to a vehicle testing facility or automotive engineering lab where students can observe NVH testing procedures on actual vehicles
3. **Acoustic Simulation Projects**: Assign students to simulate acoustic environments using software tools like MATLAB, ANSYS, or COMSOL Multiphysics
4. **Case Studies and Failure Analysis**: Present students with real-world case studies of NVH issues encountered in engineering projects or product development.
5. **NVH Software Tools Training**: Provide training sessions on NVH analysis software packages commonly used in industry, such as LMS Test.Lab, Siemens NX, or AVL Excite.
6. **Interdisciplinary Projects**: Encourage interdisciplinary collaboration by partnering NVH students with students from other engineering disciplines (such as mechanical, electrical, or aerospace engineering) on project-based learning activities.
7. **https://www.echosupply.com/blog/nvh-basics-the-science-of-sound**

OEC **Energy efficiency and Management**			
Course Code	**BAU755A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- To assess the importance of heat transfer
- To understand the various available energy storage methods
- To understand the various heat recovery methods
- To review the basics of energy audit

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby power plants, receiving stations and substations to study energy saving system and management.
3. Show Video/animation films to explain various energy efficiency and savings practices.
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teachers can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction: Review of the concepts of Thermodynamics, Fluid Mechanics and Heat Transfer, Need for energy storage, Grid balancing: Supply and demand concept for energy management. Heat transfer equipment- Heat exchangers, Steam plant

Module-2

Energy storage Methods and systems: Thermal, Electrical and Mechanical energy storage methods and systems, Energy saving in IC engines and Gas turbines.

Direct Energy Conversion methods: Magneto-hydrodynamic (MHO) power generation, Thermionic power generation, Thermoelectric power generation, Fuel cells, Hydrogen energy system

Module-3

Heat recovery systems: Incinerators, regenerators and boilers Energy Conservation: Methods of energy conservation and energy efficiency for buildings, air conditioning, heat recovery and thermal energy storage systems

Module-4

Energy Management: Principles of Energy Management, Energy demand estimation, Organising and Managing Energy Management Programmes, Energy pricing

Module-5

Energy Audit: Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries, Economic Analysis: Scope, Characterization of an Investment Project and Case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Understand the basics of Energy efficiency by reviewing the importance of energy & heat transfer
2. Choose the various efficient energy storage methods
3. Analyse the various heat recovery methods and management
4. Apply the concept to do energy audit of simple systems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Energy Management audit & Conservation, De, B. K., Vrinda Publication, 2010, 2nd Edition.
2. Energy Management, Murphy, W. R., Elsevier, 2007, 1st Edition.
3. Energy Management Hand book, Doty, S. and Truner, W. C., Fairmont Press, 2009, 7th edition

Web links and Video Lectures (e-Resources):

1. International Energy Agency Website, (Link: https://www.iea.org/)
2. Indian Renewable Energy Development Agency Limited Website, (Link: Https://www.ireda.in)
3. Ministry of Power, GoI, Website, (Link: https://powermin.gov.in/).

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **Energy Audit Projects:** Assign students to conduct energy audits for buildings, facilities, or industrial processes. Provide them with guidelines and tools for assessing energy consumption, identifying inefficiencies, and proposing energy-saving measures. Students can analyze utility bills, inspect equipment, and use energy monitoring devices to quantify energy usage and potential savings.
2. **Renewable Energy System Design Challenges**: Challenge students to design renewable energy systems (e.g., solar PV, wind turbines, geothermal heat pumps) for residential or commercial applications
3. **Energy Efficiency Retrofit Projects**: Task students with developing energy efficiency retrofit plans for existing buildings or facilities. Students can identify retrofit opportunities such as lighting upgrades, HVAC system optimizations, insulation improvements, and building envelope enhancements.
4. **Smart Grid Simulation Exercises**: Introduce students to smart grid concepts and technologies through simulation exercises. Students can use software tools like GridLAB-D or MATLAB/Simulink to model smart grid components such as smart meters, demand response systems, and grid-connected renewable energy sources
5. **Community Outreach and Education Campaigns**: Engage students in community outreach activities to raise awareness about energy efficiency and management practices
6. **https://nptel.ac.in/courses/108/106/108106022/**
7. **NPTEL Certification course: https://nptel.ac.in/courses/108/106/108106022/**
8. **BEE Certification course**

OEC Knowledge Management		Semester	7
Course Code	**BAU755B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- To introduce the fundamentals of Knowledge Management
- To expose to the concept of developing Knowledge repositories , to design a knowledge management system
- Understand the socio cultural issues, Knowledge leadership and connect the leadership skills to ICT technology and management

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various machines
3. Encourage collaborative (Group Learning) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Knowledge Influences : Introduction, External influences on organizations, Changing nature of management, Types of organizations, Strategic management in organizations, Knowledge management, Knowledge management an emerging concept, Model of strategic knowledge management.

Introduction to Key Concepts : What is Management? Knowledge Management and business strategies, Knowledge intensive firms and Knowledge workers, Learning and Knowledge

Module-2

Management Knowledge Creation and Loss : Innovation dynamics and knowledge processes, characterizing innovation processes, innovation as an interactive process, knowledge creation and Nonaka, the social dynamics of innovation networking processes, forgetting and unlearning knowledge

Developing and Managing Knowledge Repositories : Effective knowledge repositories, mapping the content structure, repository quality control, case studies (not for examination)

Module-3

Design Knowledge Management System : Introduction, Structure preserving design, Step 1: design system architecture, Step 2: identify target implementation platform, Step 3: specify architectural components, Step 4: specify application within architecture, design of prototypes, distributed architecture.

Socio-Cultural Issues : Introduction, significance of cross community knowledge processes, characterizing cross community knowledge processes, identity, knowledge, trust and social relations, classification of boundary types, facilitating/managing knowledge between communities

Module-4

Knowledge Leadership : Introduction, contributions of disciplines to Knowledge Leadership, the generic attributes of knowledge leader, specific knowledge leadership roles, leading knowledge teams, leading a knowledge network, recruiting and selecting knowledge leaders

Module-5

Information and Communication Technologies and Knowledge Management: Introduction, linking knowledge management and ICTs, objectivist perspectives on ICT – enabled knowledge management, practice based perspectives on ICT enabled KM, the importance of accounting for socio cultural factors in ICT enabled KM, debates regarding the role of ICTs in KM processes.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Understand the basics of Knowledge Management and key concepts
2. Differentiate between Knowledge creation and loss
3. Apply governing concepts of to develop Knowledge repositories and manage after due analysis
4. Use the knowledge leadership skills to and link it to ICT and Knowledge management processes

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Knowledge Management, Shelda Debowski, Wiley India, 2007.
2. Knowledge Management in Organizations, Donald Hislop, 2 nd Ed., Oxford University Press, 2009
3. Knowledge Engineering and Management, Guus Schreiber, et al, University Press India Pvt. Ltd., 2003
4 Knowledge Management - Classic and contemporary works, Daryl Morey, et. al., 2007.

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=sVtMC3GkMr0
2. https://www.youtube.com/watch?v=oPnpfyAql7Q
3. https://www.youtube.com/watch?v=_dEkwRlyszo
4. https://www.youtube.com/watch?v=8CHyfH6xsjE
5. https://www.youtube.com/watch?v=1K3mUa0-1Js

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **Knowledge Mapping Exercise:** Divide students into groups and assign each group a specific topic or domain relevant to the subject of knowledge management. Students can conduct research, identify key concepts, and create knowledge maps or concept maps to visualize relationships and connections between different pieces of information.
2. **Knowledge Sharing Workshops:** Organize workshops where students share their expertise and experiences on topics related to knowledge management. Each student can prepare a short presentation or demonstration on a knowledge management tool, technique, or best practice, followed by group discussions and feedback sessions.
3. **Knowledge Sharing Workshops**: Organize workshops where students share their expertise and experiences on topics related to knowledge management. Each student can prepare a short presentation or demonstration on a knowledge management tool, technique, or best practice, followed by group discussions and feedback sessions.
4. **Knowledge Management System (KMS) Evaluation**: Provide students with access to knowledge management systems or software platforms used in organizations.
5. **Expert Interview Series**: Invite guest speakers or industry experts to participate in an expert interview series on topics related to knowledge management.
6. **NPTEL lecture videos,**
7. **Panel discussion with Industry and Academia experts**
8. **Watch You tube videos**

OEC Human Resource Management		Semester	7
Course Code	**BAU755C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3-0-0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Examination type (SEE)	Theory		

Course objectives:

- To develop a meaningful understanding of HRM theory, functions, and practices.
- To apply HRM concepts and skills across various types of organizations.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Show Video/animation films to explain functioning of various machines
3. Encourage collaborative (Group Learning) Learning in the class
4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
6. Topics will be introduced in a multiple representation.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
9. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Human Resource Management

Introduction, meaning, nature, scope of HRM. Importance and Evolution of the concept of HRM. Major functions of HRM, Principles of HRM, Organization of Personnel department, Role of HR Manager.

Job Analysis: Meaning, process of job analysis, methods of collecting job analysis data, Job Description and Specification, Role Analysis.

Module-2

Human Resource Planning: Objectives, Importance and process of Human Resource planning, Effective HRP

Recruitment: Definition, Constraints and Challenges, Sources and Methods of Recruitment, New Approaches to recruitment.

Selection: Definition and Process of Selection.

Module-3

Placement: Meaning, Induction/Orientation, Internal Mobility, Transfer, Promotion, Demotion and Employee Separation.

Training and development: Training v/s development, Training v/s Education, Systematic Approach to Training, Training Methods, Executive Development, Methods and Development of Management Development, Career and Succession Planning.

Module-4

Performance Appraisal: Concept of Performance Appraisal, the Performance Appraisal process, Methods of Performance Appraisal, Essential Characteristic of an Effective Appraisal System.

Compensation: Objectives of Compensation Planning, Job Evaluation, Compensation Pay Structure in India, Wage and Salary Administration, Factors Influencing Compensation Levels, Executive Compensation.

Module-5

Employee Welfare: Introduction, Types of Welfare Facilities and Statutory Provisions.

Employee Grievances: Employee Grievance procedure, Grievances management in Indian Industry.

Discipline: Meaning, approaches to discipline, essential of a good disciplinary system, managing difficult employees.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Understand the importance, functions and principles Human Resource Management and process of Job analysis and the issues related to employee welfare, grievances and discipline.
2. Summarize the objectives of Human Resource planning, Recruitment and selection process
3. Analyse the job and choose right process involved in Placement, Training and development activities.
4. Make performance analysis and use an effective appraisal system and compensation planning.

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Human Resource Management- Rao V.S.P, Excel books, 2010
2. Human Resource Management- Cynthia D. Fisher, 3/e, AIPD, Chennai
3. Human Resource Management: A South Asian Perspective, Snell, Bohlander&Vohra, 16th Rep., Cengage Learning, 2012
4. Human Resource Management- Lawrence S Kleeman, Biztantra, 2012
5. Human Resource Management- Aswathappa K, HPH
6. Human Resource Management- John M. Ivancevich, 10/e, McGraw Hill.
7. Human Resource Management in Practice- Srinivas R. Kandulla, PHI
8. Human Resource Management- Luis R Gomez-Mejia, David B. Balkin, Robert L Cardy, 6/e, PHI, 2010

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/122105020.
2. http://www.digimat.in/nptel/courses/video/110105069/L26.html
3. https://www.digimat.in/nptel/courses/video/122105020/L05.html
4. https://nptel.ac.in/courses/110105069

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **Role-Playing Scenarios:** Divide students into groups and assign them HR-related role-playing scenarios such as conducting job interviews, handling disciplinary situations, or mediating conflicts between employees. After the role-play, facilitate discussions to reflect on the experience, identify effective strategies, and discuss alternative approaches**.**
2. **Recruitment Simulation:** Organize a recruitment simulation exercise where students take on the roles of HR recruiters and job applicants. Students can draft job postings, review resumes, conduct mock interviews, and make hiring decisions based on candidate qualifications and fit with organizational culture.
3. **Performance Appraisal Role-Plays**: Conduct role-plays of performance appraisal meetings between managers and employees. Students can take turns playing the role of manager or employee, providing feedback, setting performance goals, and discussing development opportunities. Encourage students to practice active listening and constructive feedback techniques.
4. **Case Studies and Problem-Solving Exercises**: Present students with case studies or real-world HR challenges and ask them to analyze the situations, identify underlying issues, and propose solutions
5. **Labor Relations Negotiation Simulations:** Conduct labor relations negotiation simulations where students represent management and labor union representatives in collective bargaining sessions. Students negotiate contract terms, address grievances, and practice conflict resolution skills to reach mutually beneficial agreements.
6. **HR Technology Demonstrations**: Provide students with hands-on experience with HR technology platforms such as HRIS (Human Resource Information Systems), applicant tracking systems, or performance management software. Students can explore system functionalities, enter sample data, and generate reports to understand how technology supports HR functions
7. **Visit to nearby HR department and explore on HRM**
8. **Engage / organize invited lectures/ webinar from HR experts**
9. **Enrol for a certification course in NPTEL**

OEC Refrigeration and Air-Conditioning Concepts		Semester	7
Course Code	**BAU755D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- Study the basic definitions of refrigerating and air conditioning systems
- Understand the working principles and applications of different types of refrigeration systems and use of refrigerants
- Learn about the psychrometry and related processes
- Study the working of air conditioning systems and their applications

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
2. Arrange visits to nearby ice plants, to give brief information about the RAC concepts.
3. Show Video/animation films to explain functioning of various machines
4. Encourage collaborative (Group Learning) Learning in the class
5. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
7. Topics will be introduced in a multiple representation.
8. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
9. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
10. Individual teacher can device the innovative pedagogy to improve the teaching-learning.

Module-1

Introduction to Laws of Thermodynamics:

Joules experiments, Statement of the First law of thermodynamics, steady state-steady flow energy equation, important applications, Simple numerical problems on steady state-steady flow energy equation, Keivin –Planck & Clausius statement of Second law of Thermodynamics, PMM II and PMM I. equivalence of the two statements;

Concept of Heat Engines and Heat pump, Simple numerical problems on heat engines/pump, Fundamentals Reverse Carnot cycle, block diagram of refrigerator & heat pump, Simple Numerical

Module-2

Refrigerants Classification of refrigerants, Desirable properties of refrigerants, environmental issues, Ozone depletion and global warming, ODP, GWP & LCCP, selection of environment friendly refrigerants, secondary refrigerants, anti-freeze solutions, Zoetropes' and Azeotropes, refrigerant: recovery reclaims, recycle and recharge. (No numerical Problems)

Module-3

Vapour Compression Refrigeration System (VCR): Analysis of Vapour Compression Cycle, Vapour Compression Refrigeration system Working and analysis, Limitations, Superheat horn and throttling loss for various refrigerants, COP, Work and Refrigerating effect

Vapour absorption systems Introduction, Working of simple vapour absorption system (VAR), desirable properties of binary mixture (aqua-ammonia), performance evaluation of simple VAR Actual VAR, LiBr absorption system, three fluid system (Electrolux refrigeration), applications of VAR, comparison between VCC and VAR. Simple numerical problems on basic VAR systems

Module-4

Psychrometry: Psychometric properties and terms, psychometric relations, Psychometric processes and its representation on psychometric chart, BPF of coil, ADP, adiabatic mixing of two air streams, SHF, RSHF, GSHF, ESHF. Simple Numerical

Module-5

Air Conditioning Systems Working of summer, winter and all year round AC systems, all air system, all water system, air water system, variable refrigerant flow and variable air volume systems, unitary and central air conditioning.(No numerical problems)

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Understand the basic working of refrigerating and air conditioning systems and identify their major components
2. Classify and compare different refrigeration systems and refrigerants
3. Choose the appropriate Refrigeration and Air conditioning systems
4. Apply the concepts to do design of basic components and capacity of simple refrigeration and air conditioning systems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Roy J. Dossat, Principles of Refrigeration, Wiley Limited
2. Arora C.P., Refrigeration and Air-conditioning, Tata Mc Graw –Hill, New Delhi, 2nd Edition, 2001.
3. Stoecker W.F., and Jones J.W., Refrigeration and Air-conditioning, Mc Graw - Hill, New Delhi 2nd edition, 1982.
4. Refrigeration and Air-Conditioning' by Manohar prasad
5. S C Arora& S Domkundwar, Refrigeration and Air-Conditioning Dhanpat Rai Publication

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses/112105128/#
2. http://www.digimat.in/nptel/courses/video/112107208/L35.html
3. https://www.youtube.com/watch?v=9uCeFhO8H40
4. https://www.youtube.com/watch?v=fcRR95Sy8_U
5. https://www.youtube.com/watch?v=j0xhc5juDak

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. **Refrigeration Cycle Demonstration**: Set up a refrigeration cycle demonstration apparatus in the classroom/lab
2. **System Troubleshooting Exercises**: Create simulated refrigeration and air conditioning systems with intentional faults or malfunctions.
3. **Load Calculation Projects:** Assign students to conduct load calculations for residential or commercial buildings to determine heating and cooling requirements. Students can analyze factors such as building size, insulation levels, occupancy patterns, and equipment loads to size HVAC systems appropriately.
4. **Field Trips to HVAC Facilities**: Arrange field trips to HVAC manufacturing facilities, testing laboratories, or commercial HVAC installations.
5. **VTU, E- learning, MOOCS, Open courseware; NPTEL Certification Course: https://nptel.ac.in/courses/112105129; NPTEL Certification Course: https://onlinecourses.nptel.ac.in/noc21_me85/previewNPTELCertification Course https://onlinecourses.nptel.ac.in/noc19_me58/preview**

Major Project - Phase II	Semester	7

Course Code	**BAU786**	CIE Marks	100
Teaching Hours/Week (L:T:P: S)	0:0:12	SEE Marks	100
Total Hours of Pedagogy	12 HRS/WEEK	Total Marks	200
Credits	06	Exam Hours	3
Examination type (SEE)	Theory/practical/Viva-Voce /Term-work/Others		

PROJECT WORK (BAU685 and BAU786): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.

(iii) To impart flexibility and adaptability.

(iv) To inspire team working.

(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines.

(vii) To install responsibilities to oneself and others.

(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

SEE procedure for Project Work: SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25.

8TH SEMESTER

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Automobile Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VIII SEMESTER (Swappable VII and VIII SEMESTER)

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PEC	BAU801x	**Professional Elective (Online Courses)**	AU	3	0	0		03	50	50	100	3
2	OEC	BAU802x	**Open Elective (Online Courses)**	AU	0	2	0		01	50	50	100	3
3	INT	BAU803	**Internship (Industry/Research) (14 - 20 weeks)**	AU	0	0	12		03	100	100	200	10
										200	**200**	**400**	**16**

Professional Elective Course (Online courses)

BAU801A	To be Announced on the VTU web portal	BAU801C	To be Announced on the VTU web portal
BAU801B	To be Announced on the VTU web portal	BAU801D	To be Announced on the VTU web portal

Open Elective Courses (Online Courses)

BAU802A	To be Announced on the VTU web portal	BAU802C	To be Announced on the VTU web portal
BAU802B	To be Announced on the VTU web portal	BAU802D	To be Announced on the VTU web portal

L: Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship / Research Internship / Rural Internship

Note: VII and VIII semesters of IV years of the program

Swapping Facility

- Institutions can swap VII and VIII Semester Scheme of Teaching and Examinations to accommodate **research internships/ industry internships/Rural Internship** after the VI semester**.**
- Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether VII or VIII semester is completed during the beginning of IV year or later part of IV year of the program.

Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize, appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.

The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their hometown (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide. **University shall not bear any cost involved in carrying out the internship by students.** However, students can receive any financial assistance extended by the organization.

Professional Elective /Open Elective Course: These are ONLINE courses suggested by the respective Board of Studies. Details of these courses shall be made available for students on the VTU web portal.